

of latitude is great; and (c) when the two places under consideration are on different sides of the Equator. In these cases Mercator's sailing should be used." And again, on p. 104, when speaking of a ship's journal (which I considered the right place to introduce it), I give this caution:—

"As longitude by inspection depends on the middle latitude, the cases in which it should not be used as explained under middle-latitude sailing should be attended to: and if the latitude be high, or the distance made good be great on a small course, then correct longitude can only be obtained by finding the position of the ship by Mercator's sailing on every change of course."

JOHN MERRIFIELD

Navigation School, Plymouth, December 22, 1883

[I WAS, of course, aware of the existence of the paragraphs mentioned by Mr. Merrifield, but they do not seem to meet the point raised, viz. that no notice was taken in the chapter on *Traverse Sailing* of the necessity of finding the difference of longitude on each course in high latitudes, although the subject is incidentally referred to at p. 104. There will doubtless always be differences of opinion between the writer and reviewer of a book, but it seems to me that, in teaching, the theory should be unassailable. Whether in practice it is necessary to apply all the corrections required should be left to the judgment of the practitioner. Mr. Merrifield has reversed this order, having omitted certain rules from the instructions on *Traverse Sailing*, but mentioned them casually in a paragraph preceding the copy of the log.—THE REVIEWER.]

AN AMERICAN ROTHAMSTED

HALF a century has elapsed since Sir John Lawes commenced at Rothamsted Park, in Hertfordshire, the unique series of experiments the results of which have produced so salutary an effect on agricultural practice. The inquiries were at the outset restricted to determining the influences of various kinds of manures, and these led to the institution, in the year 1843, of systematic field experiments which are still in progress. Wheat and barley have been grown on the same land for forty-one consecutive years, oats for twelve years, turnips for thirty years, potatoes for nine years, meadow herbage for twenty-eight years, while beans, clover, sugar-beets, and mangel-wurzel have likewise been grown more or less continuously, and all under the varied influences of the different manurial agents. The influence of soils and manures on the composition of crops, the relations of botanical characteristics to the soil and to manures, the physical and chemical properties of the soils themselves, the transpiration of water by plants, the question as to whether plants assimilate free nitrogen, the composition of rain and drainage waters,—these are some of the chief problems which have been the subjects of research. Not less noteworthy are the experiments which have been made with animals, such as the determination of the relation of quantity and kind of food consumed to increase in live weight, the proportion and relative development of the different organs of farm animals, the composition of the animals in different conditions as to age and fatness, the composition of the solid and liquid excreta in relation to that of the food consumed, and the composition of the ash of animals in different conditions and variously fed.

Valuable and highly appreciated as are the many published results of the Rothamsted researches, yet their significance could not fail to be greatly enhanced were it possible to compare them with similar experiments carried on elsewhere. But the efficient equipment of an agricultural experiment station like that at Rothamsted is a very costly affair, and, unless State aid can be relied upon, it can hardly be undertaken save through the munificence of private individuals. The splendid example set by the founder of the Rothamsted station in this country has stimulated an American gentleman to establish in the State of New York an experimental farm which is already well on the way towards becoming another Rothamsted.

The credit of this enterprise is due to Mr. Lawson Valentine, who thereby realises "a long-cherished plan for doing something towards the progress of American agriculture," and at the same time providing a pleasant country home conveniently near his place of business in New York City.

Houghton Farm, Orange County, is within two hours' railway journey of New York City, and occupies an area of 600 acres. In the summer of 1879 the proprietor secured the services of Dr. Manly Miles as director of the projected experiments, and after a period of eighteen months, during which the fields were laid out and drained, the experiments were begun. Since the summer of 1881 the experimental work has been carried on as a distinct department, quite separate from that of the farm proper on the one hand, and from that of the residential portion of the estate on the other. Thus the present plans as to Houghton Farm are, in the words of the proprietor, the following:—1. That the farming operations be carried on in accordance with the best known methods, and under the best possible organisation and management, with a view to educating and enlightening others by furnishing valuable examples and results in practical agriculture. 2. That there be a scientific department devoted to agricultural investigation and experiment, and that such department be of the highest order, so as to command the respect, interest, and co-operation of the leading scientific minds of this and other countries. 3. That Houghton Farm be a comfortable, healthful, and attractive home for the family of its proprietor, and afford large hospitality for friends and guests.

Two distinct though closely related and parallel lines of investigation are recognised. Firstly, the purely scientific work of the laboratory to gain a knowledge of the elements of animal and vegetable nutrition, and of their relations under known definite conditions. Secondly, accurate and well planned experiments in the feeding of animals and in the growth of crops to answer the various practical questions that arise in the management of the farm, and to determine the agricultural value of the facts and theories that are presented as the result of purely scientific investigations. Experiments under this second head demand, on the part of those who conduct them, an extended knowledge of practical farming, as well as the trained skill and ability for original investigations that are required in researches in pure science.

As the system of growing the same kind of crop on the same land for a continuous series of years, in the manner followed at Rothamsted, appears to be the only one that can be relied upon to give consistent and trustworthy results, this method has been adopted at Houghton Farm. But besides wheat, barley, and oats, the staple American cereal, Indian corn, forms the subject of a special series of experiments. Indian corn is successfully cultivated over a very wide area; it much exceeds in aggregate value any other crop grown in the United States; it is of great importance as a cleaning crop; and the large amount of cattle food of good quality it is capable of yielding, together with the value of the manure produced per acre when it is fed on the farm, all point to this crop as the one a series of systematic experiments upon the cultivation of which will yield results of greater practical interest to American farmers than will experiments with any other field crop.

The first report on the experiments with Indian corn has already been published, with considerable elaboration of detail. Some interesting results have been established, particularly those on the influence of drainage, on the employment of barnyard manure, and on the character and quality of the grain.

Prof. D. P. Penhallow, the botanist and chemist at the station, has issued no less than four reports last year and this. These deal respectively with the meteorology of the district in which the farm is situated, based

on observations extending over a period of six consecutive months; with soil temperatures, a series of observations embracing a similar period; with the normal condition of vegetable structure with reference to cell contents; and with "peach yellows," a disease attacking peach trees. To do justice to any one of these memoirs would really require a separate notice, but the mere mention of them will serve to indicate some of the channels into which the energies of this new centre of research are being directed. In connection with the meteorological work, however, it is worth noting that daily bulletins were issued, the predictions being made for twenty-four hours from noon to noon. The whole number of predictions made was 210, of which only 19 per cent. proved incorrect, so that the bulletins came to be depended upon and served a most important purpose for the time during which they were issued. All the reports are printed in an attractive form, and special pains appear to have been bestowed upon the diagrams and coloured plates.

To the names that have already been mentioned it is necessary to add that of Mr. Henry E. Alvord, who has undertaken the duties of general manager. Mr. Alvord's name is already familiar to agriculturists on this side of the Atlantic, particularly in connection with American dairy farming, and his association with Houghton Farm is another guarantee, if one were needed, of the thoroughly business-like manner in which the new experiment station is to be conducted.

From this brief sketch it will be seen that there exist at Houghton Farm potentialities whose development can hardly fail to exercise considerable influence on the agricultural practice of the future. Those who have studied the Rothamsted results will be glad to compare with them the results deduced from the Houghton Farm experiments, and each station will be benefited by comparing notes with its friendly rival, while the valuable work which English agriculturists associate with the names of Lawes, Gilbert, Pugh, Masters, and Warrington will, it is to be hoped, find a parallel in the discoveries we shall confidently look for from the transatlantic station. Intentionally planned, in many details, upon the same lines as Rothamsted, there is one point in which the new station specially resembles its English prototype, and it is contained in the words, "Visitors are always welcome at Houghton Farm."

W. FREAM

EDELMANN'S ELECTROMETER

AMONGST the many forms of electrometer that derive their origin from the quadrant electrometer of Sir William Thomson is that of Edelmann, which is very extensively used in the physical laboratories of the Continent. Dr. Edelmann, whose name it bears, is not only proprietor of workshops in Munich, which are rapidly winning renown for the excellence of the instruments which they turn out, but also holds the post of *privat-docent* in the Polytechnicum of Munich.

In the parent instrument of Sir W. Thomson, and in most of the modifications of that instrument which go by the names of Branly, Kirchoff, Mascart, &c, the quadrants are literally four quadrants cut from one plane circle; and in most of these instruments the *needle* is of the flat dumb-bell or lemniscate form which Sir W. Thomson himself gave to it. Dr. Edelmann has, however, taken a departure in quite another line, his instrument being very appropriately named the "cylinder-quadrant" electrometer. The three accompanying figures show the essential parts of the instrument. The quadrants, marked G in Fig. 1, and a, b, c, d in Fig. 2, are formed by taking a metal tube, furnished with flanges above and below, and slitting it into four parts by four equidistant cuts parallel to the axis of the tube; the four pieces being then set in their proper places by being screwed to two rings, R and S, of ebonite. This arrangement has some

advantages over those of the ordinary quadrant electrometers. In these, when the quadrants consist of four pieces of flat brass borne each on an insulating pillar, it is difficult to set them so that they shall be all exactly in one plane; and when, as in some of the more delicate instruments, the quadrants are made of a hollow box slit into four parts, there is found the further difficulty of arranging the quadrants so that the needle can be taken out and replaced. These difficulties are, to a large extent, obviated in Dr. Edelmann's form of instrument; for the inner surface of the cylinder, which constitutes the four quadrants, can be turned perfectly true after the quadrants have been screwed to the ebonite rings; and there is no difficulty at all in lowering the needle into the cylindrical cavity within the quadrants, or in lifting it out. The needle itself is of the form shown in Figs. 2 and 3, and

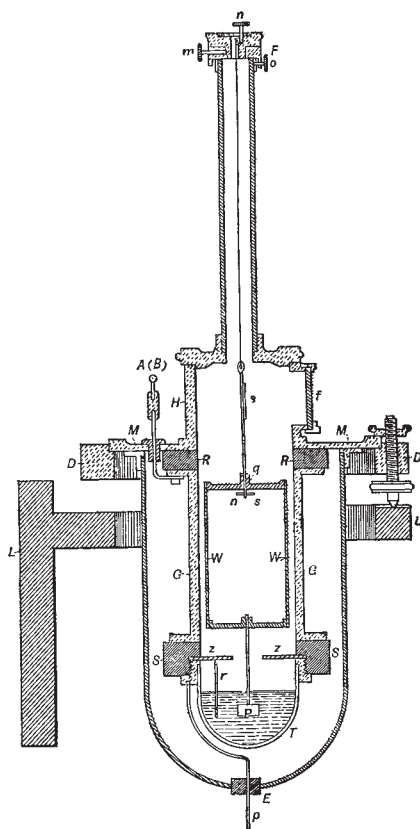


FIG. 1.

consists of two portions of metal (w w) cut from a cylinder, united above and below, and hung by a single fibre of small torsion from an adjustable head, F, above. A mirror, s, is attached above the needle, and a platinum vane, p, below it dips into a vessel, T, containing sulphuric acid. To give directive force to the "needle" a small magnetic needle, n s, is attached to it. This device was indeed used in some of Sir W. Thomson's early instruments, though subsequently abandoned in favour of the bifilar suspension usually adopted. It is of course understood that the opposite pairs of quadrants are, as usual, connected together. Electrodes, A, B, pass through the metal plate, M, which covers the instrument, and are connected with the quadrants as shown in Fig. 1. An outer jar of glass surrounds the instrument and is fixed to the under side of the plate M by a bayonet point. The plate M itself is very substantial, and is provided with three levelling screws which rest in V-grooves in a strong ring-